

# REVIEWS OF BOOKS

## CYTOLOGY

**Schrader, Franz.** *Mitosis*. New York, 1944. Columbia University Press. London, Oxford University Press. Pp. x + 110. Price \$2.00.

THE word *mitosis* has come to have two rather distinct meanings, corresponding to two phases in the growth of cytology. Among those interested in the genetic implications of cell division, mitosis is taken to refer to somatic cell division only, as distinct from meiosis or the reduction division. In the older and original meaning, to which the author of the present monograph adheres, mitosis refers to the spindle mechanism and to chromosome movement in any cell division, whether somatic or reductional.

During many years Professor Schrader's laboratory at Columbia has been making important contributions to the problems of cell division. Professor Schrader's own work has been largely devoted to a group of insects, the *Hemiptera*, in which the variety of chromosome mechanisms is unequalled in any other even much larger group of organisms. Cytologists will therefore turn to Professor Schrader's new book with high expectations, and they will not be disappointed.

The nature of cytological knowledge must be quite unique among observational sciences. Cell division has been observed countless times, at every stage and in minute detail, in a great variety of organisms. The processes are complicated, but it is agreed that they are fundamentally the same in all forms of life. Yet in spite of this very extensive information, we are still without a scrap of real evidence as to the actual physical nature of the mechanisms and forces involved. The chromosomes arrange themselves on a metaphase plate. Why? What pushes or pulls them there? They split and go to the poles at anaphase, but what are the forces and how do they act? We do not

know. The situation is at once tantalizing and humiliating in the extreme.

About one-half of the book is devoted to the spindle, the other half to the movement of chromosomes. Within these subdivisions the subject is mainly treated historically, as a systematic and critical review of the various hypotheses that have been put forward, and of the evidence in their support, and against them. Extreme fairness and critical sense are evident throughout. In this book we find at its best what is so conspicuously lacking in certain contemporary cytological texts, namely the ability to see all sides of a question and to balance the evidence between them; there is also a genuine humility before the unknown. That this is a considerable achievement will be obvious to anyone who has followed the polemics that have existed in chromosome cytology during the last twenty years. It might even perhaps be said that the author's desire to be fair runs at times to excess, particularly in dealing with theories put forward in the very early days of chromosome cytology.

The desire to keep the book within the narrow compass of a hundred-odd pages has resulted in the rigorous exclusion of all material not directly bearing on the problem. Within these limits there can be nothing but praise for the work. But many readers will regret that the author has not allowed himself a little more scope in some directions. It seems to the reviewer, for instance, that the application of a little elementary physics to the problem of chromosome movement would have been very profitable, if only to distinguish between hypotheses which are plausible and those which are physically improbable. For not a few have been put forward in apparent contradiction of laws which almost certainly apply. From this point of view, it is important that chromosome movement on the spindle is at a rate which is, very roughly, uniform. It is therefore unlikely that forces inversely proportional to the square or to some higher power

of the distance are operative. As an extreme example of this, it is not difficult to calculate that a centrosomal Bjerknes force inversely proportional to the seventh power of the distance, in order to attract chromosomes from the plate to the pole over a distance of several micron, represents an energy dissipation so enormous as to be quite impossible in living organisms. Yet such a theory has been put forward. Similarly, some discussion of the chemistry of chromosomes would have been very profitable, for in this

field at least we seem to have acquired some real knowledge during the last ten years or so. The best hope for future progress would be, perhaps, if Professor Schrader's monograph were to fall into the hands of some physical chemist who would be prepared to treat the problems of cell division by his own methods.

In the meantime, all biologists will be grateful to Professor Schrader for his admirable summary of a difficult and controversial subject.

A. C. FABERGÉ.

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